Enabling Deployment of Biobased Fuels and Products

Argonne NATIONAL LABORATORY

Analyzing the Impact of Biomass Technologies

Argonne provides the U.S. Department of Energy and its industrial partners with critical modeling and analysis tools to help evaluate the impact of biomass technologies and improve production processes. Among these are:

TOTAL LIFECYCLE MODELING

Argonne's Greenhouse gases, Regulated Emissions and Energy use in Transportation (GREET) model is the industry-standard-setting model that allows researchers to calculate the energy use, greenhouse gas emissions and criteria air pollutants from production of transportation fuels, including biofuels, on a full fuel-cycle basis.

PROCESS MODELING FOR BIOREFINERIES

Argonne's process design modeling aids in the development of integrated biomass refineries; it evaluates alternate approaches for reducing internal energy consumption and integrating process streams to yield better overall economy. At the same time, it focuses those engineering efforts that are needed to improve plant performance.

INTEGRATED ENERGY SYSTEMS ANALYSIS

Argonne energy systems analysis models evaluate biofuels' place within the energy system, when both energy flow balances and economics are considered. The Energy and Power Evaluation Program (ENPEP), the Electricity Market Complex Adaptive Systems Analysis (EMCAS) model, the All-Modular Industry Growth Assessment Model (AMIGA/MARS), and the ENERGYCAS model can be configured to focus on national, regional, or statewide issues of interest.

LONG-RANGE, GLOBAL-SCALE MODELING

Combining Argonne's expertise and facilities in high-performance computing, energy, and environmental sciences, researchers conduct long-range, global-scale modeling of the economic, human, and ecological impacts of a substantial increase in the use of biofuels.

Deploying Process Technologies

Argonne's research in integrated fermentations and separations ranges from bench-scale through commercial demonstration; the emphasis is on applied technology demonstration that often includes design and operation of large-scale facilities based on strategic partnerships with industry:

ACCELERATED PRODUCT INTRODUCTION

With Argonne support, Coskata, Inc., established a research program for production of ethanol from wood and other wastes using syngas fermentation. Coskata was able to hire and train staff, design and rapidly set up an experimental facility for safe syngas handling and fermentations, and start screening proprietary microbial strains. Separately, Coskata employed Argonne's GREET model to determine the environmental impacts of ethanol produced from its propriety syngas fermentation process. Based on this rapid deployment, Coskata announced relationships with GM and ICM.

ONE-STEP PROCESS FOR PRODUCT PRODUCTION AND CAPTURE

Argonne worked with ADM to optimize the production and recovery of large-volume organic acids using Argonne's patented Separative Bioreactor technology. The technology integrates continuous bioconversions and separations into a single step that greatly increases the rate of production—resulting in dramatic downstream savings, both in cost and energy.

LOW-COST, ENVIRONMENTALLY FRIENDLY SOLVENTS

Based on Argonne's patented purification-separation manufacturing process, Vertec Biosolvents was formed to sell environmentally friendly solvents made from ethyl lactate.

STREAMLINED SYNTHESIS GAS CLEAN-UP

Argonne and Kingston Process Metallurgy have developed a novel process that could completely change the clean up of conventional synthesis gas from coal gasification. The process employs molten copper to convert hydrogen sulfide to sulfur dioxide while reforming other contaminants to their elemental constituents, offering the potential for significant capital cost reductions and efficiency improvements.

Improving Technologies Thru Scientific Discovery

Argonne's biomass research team brings together scientists and engineers from many disciplines to conduct consequential research, resulting in technologies that support DOE's mission to increase the production and use of biofuels.

COMPUTATIONAL ANALYSIS GENOMIC SEQUENCE DATA

Argonne researchers are working to predict protein-coding genes in the sequence data, and will subsequently use a variety of sequence analysis techniques to describe the functions for those genes. Additionally, Argonne plans to reconstruct the metabolic pathways encoded in the genomic sequence data. Based on the results of this work, suggestions for metabolic engineering of bacteria can be derived leading to more efficient biomass production and/or biofuel production.

CATALYTIC PROCESSES FOR CONVERTING BIOMASS TO BIOFUELS

Argonne is developing new and improved catalysts and catalytic processes for converting biomass-derived syngas to ethanol with higher selectivity and conversion than the current state-of-the-art mixed alcohol synthesis catalysts, and for directly converting cellulose to ethanol and synthetic gasoline and diesel fuels.

ALTERNATIVE FUELS TESTING IN ENGINES AND VEHICLES

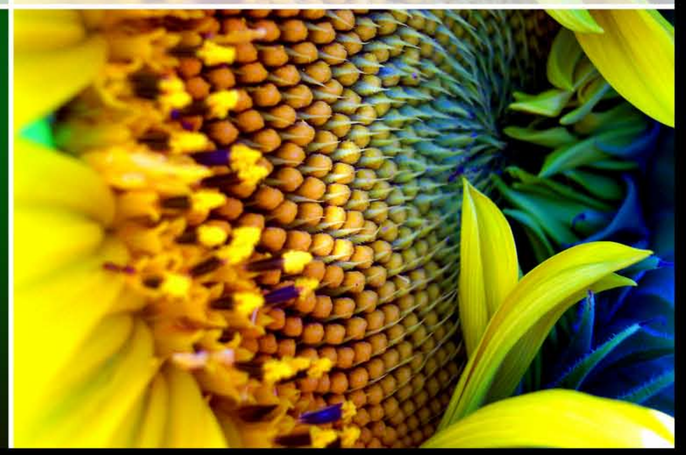
Argonne is acquiring and disseminating emissions, efficiency, and performance data from engines as well as vehicles operating on fuels such as ethanol, butanol, biodiesel, and synthetic diesel. Argonne's vertically integrated research team is working to bridge basic combustion research and applied engine systems, with the goal of improved understanding and operation of various alternative fuels.

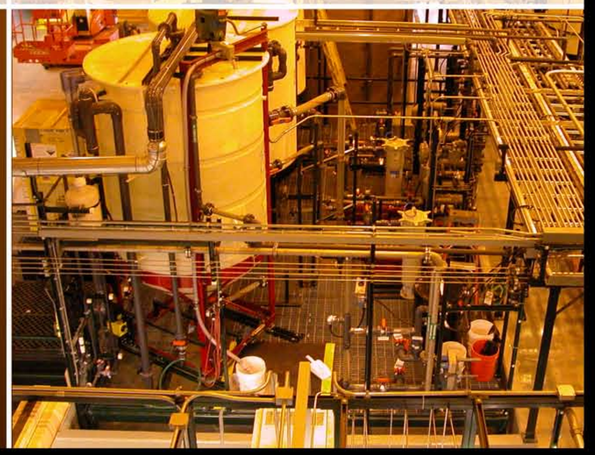
USING WATER AND LAND TO MAXIMIZE YIELDS

Argonne is evaluating and testing efficient ways to use water and land resources in order to maximize yields of lignocellulosic feedstock, while at the same time ensuring sustainability and environmental conservation.

PREDICTING, VALIDATING, AND MODIFYING FUNCTIONS OF CELLULASES FOR BIOMASS DEGRADATION

Argonne's bioinformatics tools together with high-throughput protein expression, functional analysis, and structure determination capabilities are being used to identify putative cellulases from genome sequence, validate the actual function of the proteins encoded in the DNA, and study the effects of structural modifications on enzyme function. These efforts will help in the discovery of new enzymes that will facilitate the conversion of biomass to transportation fuels.





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